CAPACITIVE TOUCH PANEL DEVICE

[0001] This application is a continuation application of co-pending U.S. application Ser. No. 13/472,388, filed May 15, 2012, the subject matter of which is incorporated herein by reference.

FIELD OF THE INVENTION

[0002] The invention relates to capacitive touch panel devices. The invention further relates to a method for determining a touch location on a capacitive touch panel device, and to an electronic apparatus comprising a display and a touch panel device.

BACKGROUND OF THE INVENTION

[0003] Capacitive touch panel devices are widely used to allow user interaction with electronic devices. In particular, a transparent touch panel can be used on top of a display device to allow a user to interact with the electronic device via a graphical user interface presented on the display device. Such touch panels are used in for example mobile phones, tablet computers, and other portable devices.

[0004] A known touch panel for use with such devices comprises a glass plate provided with a first electrode comprising a plurality of first sensing elements on one face of the glass plate, and a second electrode on an opposite face of the glass plate. The core operating principle is that the touch panel is provided with means for determining (changes in) the capacity between any of the first sensing elements of the first electrode and the second electrode. Such change in capacitance is attributed to a touch event, sometimes also called a gesture or touch gesture. By determining the position of the sensing element where the change in capacitance is maximized, the central position of the touch event is determined.

[0005] In coplanar touch panels the sensors are located in one single (Indium Tin Oxide, ITO) layer and each sensor has its own sense circuitry. Coplanar touch technology uses differential capacitance measurements in combination with a coplanar touch sensor panel. The sense circuit measures the charge that is required to load the intrinsic capacitance of each individual sensor and in addition (if applicable) the finger-touch-capacitance for those sensors that are covered/activated by the touch event. The intrinsic capacitance of the sensor depends on the sensor area, distance to a reference (voltage) layer and the dielectric constant of the materials between sensor and this reference layer. Assuming that the intrinsic capacitance is stable and constant over time, this is accounted for during the tuning/calibration procedure. The variation of sensor capacitance due to a touch event will then be the discriminating factor revealing where the touch is located.

[0006] The accuracy performance of a touch panel is the most important characteristic of the functionality of a touch panel as it shows the capability of recognizing a touch event on the same position as the actual spot location of the physical touch. Next to this, a high accuracy will improve the ability of determining the shape and size of the touch event. Moreover, a high spatial accuracy performance of a touch display will enable to correctly recognize stylus input (i.e. touches with a relative small impact diameter<4 mm).

[0007] In general, the accuracy of a touch panel with a fixed size will increase by enlarging the sensor density i.e. the total number of active touch sensors per display area. With a larger sensor density per area, not only the position, but also the shape and size of the touch can be detected with more accuracy. For a typical touch application of a pixilated display panel, (in which as a response of the touch event, part of the display will be activated/selected), the ultimate touch sensor dimension will be equal to the display pixel sensor or in other words: the maximum accuracy can be achieved when the touch sensor density is equal to the Pixels-Per-Inch (PPI) value of the display.

[0008] For various reasons, such as costs, design and process capability (track/gap capabilities) and display form factor (e.g. availability for track/routing layout) the number of I/O of the touch driver/controller will be limited. Consequently, the number of touch sensors of a touch panel of a display module will, in general, be much smaller than the actual number of display pixels which will have its negative impact on the achievable accuracy. Normally, for stylus input (i.e. with only a small area touching the surface, <4 mm diameter), a relatively higher accuracy is requested than for a finger input (with larger area touching the touch panel, i.e. 9 mm diameter). This is because a stylus input is related to typical touch display functionalities such as line drawing and hand-writing which requires a small spatial input (and recognition).

[0009] Especially, in the situation when the sensor size dimensions of the touch panel are larger than the physical touch contact area (e.g. finger touch size, stylus point size) a 'death area' can occur: i.e. the finger or stylus can move around for a certain small distance at the center of a sensor. In this case, the touch panel will not register these small movements being located within one single sensor outline.

SUMMARY OF THE INVENTION

[0010] It is an object of the invention to increase the accuracy performance of a touch panel with a fixed lay-out (i.e. fixed number of sensors, with a fixed area per sensor).

[0011] The invention provides a touch panel having a high-resistive layer at a location above of the sensor layer. The functionality of this added layer will be to spread out the electrical field between the physically touch contact area towards the array of sensors that is positioned underneath the added layer. The number of sensors that will sense a (part of the) capacitive difference due to the finger touch capacitance will be increased by this layer. The typical resistance of the additional layer should be large enough to avoid that the layer will act as a (conductive) shielding layer (typically>1-5 MOhm) but small enough in order that it will not act as fully electrical insulator<<10^8 MOhm). As a consequence of the added layer, a touch event will not only build up a capacitance between the physical touch input area and the sensor array, but via the added resistive layer a larger so called 'fringe field' area will be established, in which a larger area of the sensor array will be sensing a capacitance variation.

[0012] As a consequence, as more sensors are 'affected' by the touch event, by applying a dedicated algorithm to calculate the touch position, a higher accuracy can be achieved. Especially in the case of relative small touch input areas (e.g. at stylus input<4 mm), the number of sensors involved in the determination of the position could be increased and consequently the accuracy could be improved. In effect, the "dead area" of a touch sensor is reduced through the capacitive spreading effect of the resistive layer.